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A METEOROLOGICAL TRIP TO THE ARCTIC CIRCLE

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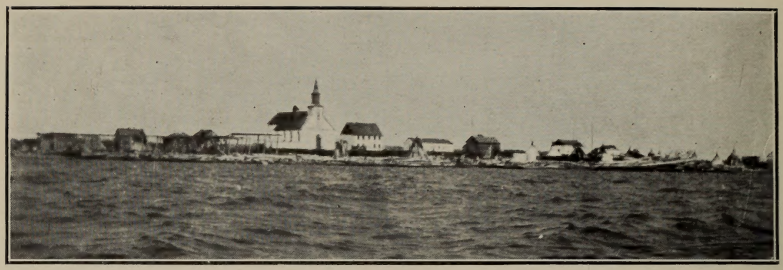

Photo by Campbell Young, Edmonton.

FORT RESOLUTION WITH ROMAN CATHOLIC CHURCH IN FOREGROUND
All the 'forts' on the Mackenzie resemble this

NORTHERN TRADING'S CO'S. BUILDING AT FORT NORMAN.
(Lat. 64° 55′ N.). Wild roses in bloom in the foreground. June 30, 1914.

CULTIVATING POTATOES AT HAY RIVER. (About July 1).

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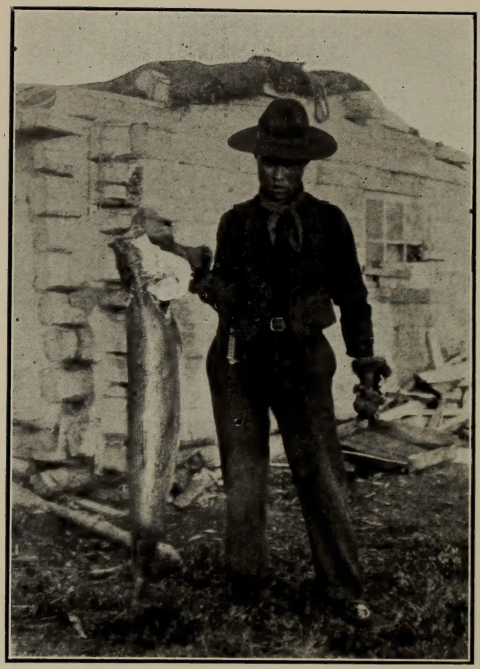

THIRTY-NINE POUND INCONNU. (*Stenodus Mackenzii*).
Caught by the R.N.W.M.P. at Fort McPherson, July 15, 1914.
This specimen is now in the University of Toronto Museum.

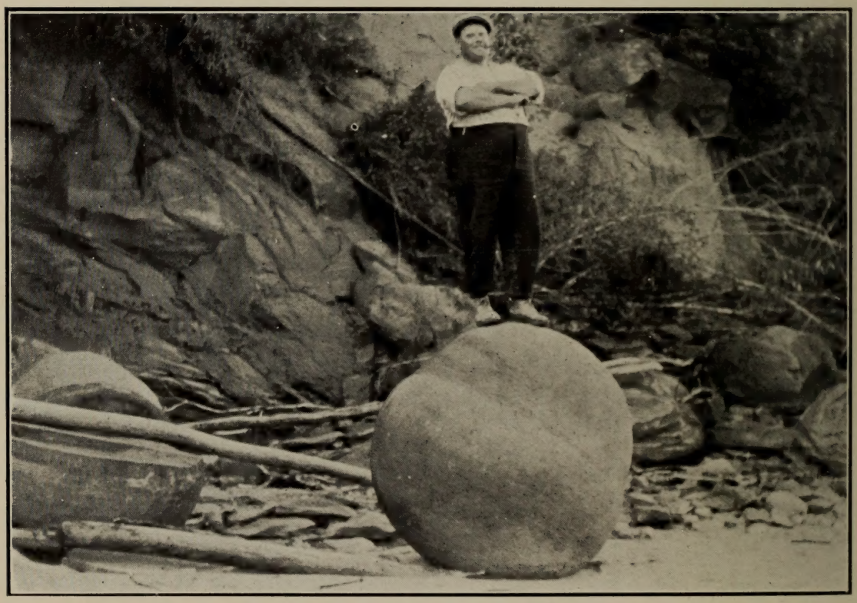

Photo by Campbell Young, Edmonton.
LARGE GLOBULAR CONCRETIONS IN SOFT SANDSTONE AT THE GRAND RAPIDS, ATHABASKA RIVER.
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A METEOROLOGICAL TRIP TO THE ARCTIC CIRCLE

By J. Patterson

THE purpose of my trip was to inspect the meteorological stations in the Mackenzie River Basin and to equip two stations in the Arctic regions, Fort Good Hope, Lat. 66° 16′, Long. 128° 54′, and Fort McPherson, Lat. 67° 27′, Long. 134° 51′, as well as to supply the Canadian Arctic Expedition with instruments and materials for despatching balloons and following them with theodolites, in order to get the velocity and directions of the air currents in the upper atmosphere ; an investigation undertaken by an International Meteorological Committee. To carry out the latter it was necessary to take a large quantity of material, and to do the former to go by a small boat or canoe most of the way. Steamers ply on the Mackenzie from Fort Smith to Fort McPherson, a distance of 1300 miles, but as they only stop for a few hours at each post at any time of the day or night, it was not possible to travel on them and to properly inspect the meteorological observatories.

The present route down the Athabaska River from Athabaska Landing has been used since the advent of the railway to

Edmonton, but before that time it was by way of the Churchill and Clearwater River to its junction with the Athabaska, after which the routes were the same. It is, perhaps, fortunate that by the present route all the rapids occur in the first 250 miles of the journey from the Landing to Fort McMurray at the junction of the Clearwater. Only barges, scows and small boats can navigate this portion of the river and then only with skilful steersmen who know every crook and turn in the river.

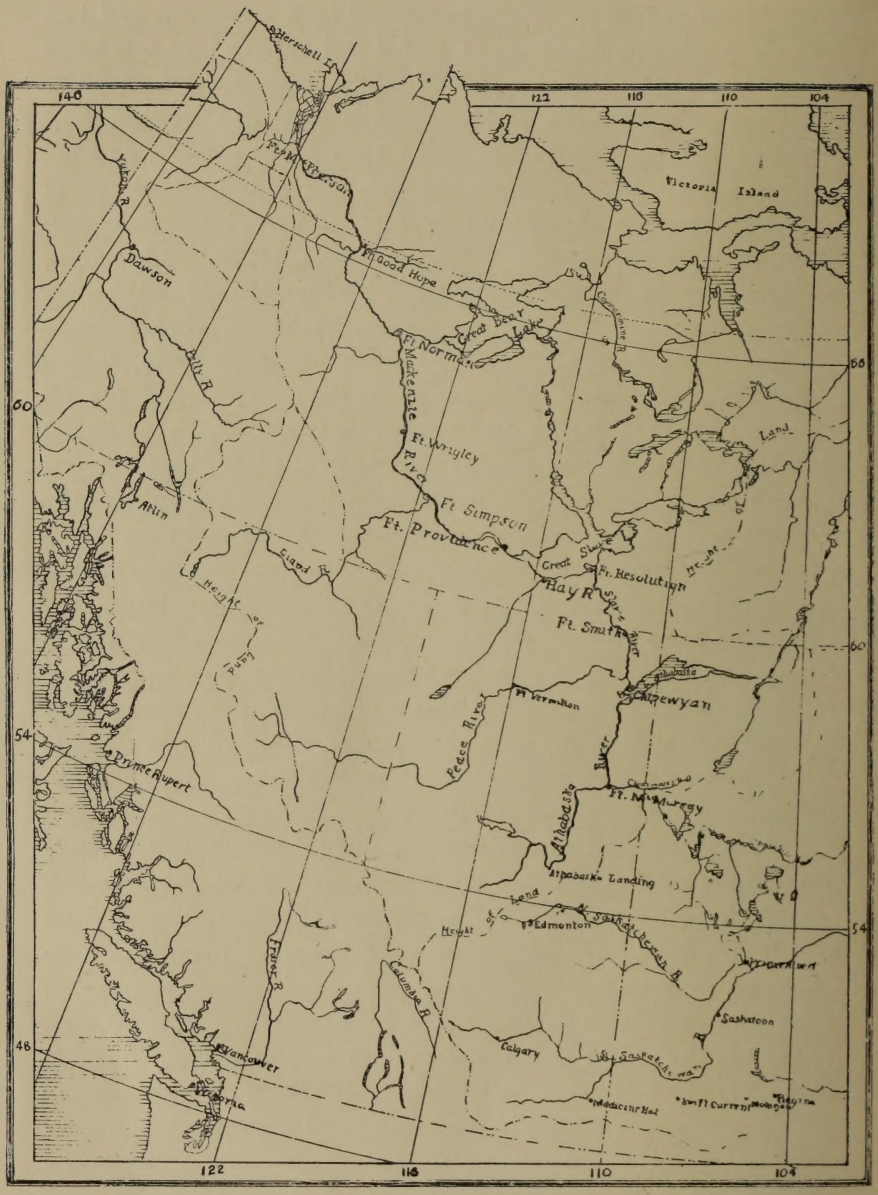
The great industry in all this region, is of course that dealing with fur, and ever since Peter Pond in 1778 guided his frail bark down the Clearwater and the Athabaska, this region has been noted for its furs, and to-day is probably the chief fur region in North America. All trade in this vast area is thus primarily in connection with the fur trade and will remain so until transportation is such that the country will be easy of access by railway to Ft. McMurray. Yet even now prospectors, surveyors and free traders are making their way into the country. The Hudson Bay Company is the largest and best known company to-day in that part, and ever since the amalgamation of the old Northwest Fur Trading Co. with the Hudson Bay Co., they have unitedly fought just as strenuously to keep all other traders out, as formerly they fought each other ; so successful have they been in this that at the present day they have only one serious rival in the whole of the region and that is the Northern Trading Co.

In addition to these two companies, independent traders, taking in a small outfit, trade and trap for a winter and return the next season by way of the Yukon or the Mackenzie.

The Northern Trading Company agreed to furnish me with transportation ahead of the steamers to enable me to do my work properly, and Mr. Campbell Young, the General Manager, was most obliging and arrangements for me very satisfactory. They set out on May 4th from the Landing with ten scows, a crew of between forty and fifty and about ten passengers ; the scows are 60 feet long, 12 feet wide and 3 feet deep and hold from 6 to 9 tons according to the stage of the water in the river ;

each scow costs $150.00 and is manned by a steersman and two or three oarsmen who have to be fed and supplied with tobacco in addition to their wages ; so all told it costs about $500.00 to get a scow down to Ft. McMurray, a distance of 250 miles. The motive power is the current which runs fairly steadily at from 3 to 4 miles an hour, the men row little, except to keep the boat in the current and at the rapids ; the first 120 miles are passed without incident, except that, for some distance from the Landing, evidence of the forward march of civilization is seen in the farm houses dotted here and there along the banks, then solitude reigns until one approaches the Pelican, the first rapid, where derricks proclaim the presence of the prospector and the oil region : so far they have had only prospects of oil, but in one of the wells sunk 16 years ago gas was struck and it has been burning ever since, wasting enough gas to light many of the cities of the West ; its roar can be heard a mile away and by night the illumination is visible to great distances. Here the troubles begin ; the river is shallow and swift, and I had my first exhibition of boat repairing in an emergency as one of the scows struck on a rock and was punctured. A case of crisco was convenient and was broken open with one blow of an axe, the contents were quickly softened in the mouths of the boatmen and then plugged into the hole, a board being nailed over the top to hold it in place, and the operation was done.

Passing through three small rapids, the Grand Rapids of the Athabaska were reached 6 days after setting out. Above this point the soil is clayey, but here a soft sandstone formation filled with globular concretions appears and the river has cut a deep channel through it, which is filled with these enormous boulders ; the fall amounts to about 80 feet in less than a mile and an island in the centre of the river divides it into a main channel which is not navigable, and a smaller one through which scows can be run partly loaded in high water and empty in low water ; all the cargo is unloaded at the head of the island and taken across on a tram-line, the property of the Hudson Bay Co., who charge $2.00 a ton for the privilege of getting the freight across,



MAP OF THE MACKENZIE RIVER BASIN

you doing all the work yourself, even to furnishing the motive power for the tram-car. The scows are run through the channel and then hauled up to the loading place, loaded up and started again. It required about ten days to work all the scows through. After leaving the Grand Rapids one passed in succession, the Brulé, Boiler, Middle, Long, Crooked, Stony, Little Cascade, Grand Cascade, Mountain and Moberly. At the Boiler, so called because the Hudson Bay Co. lost a boiler there many years ago, the tar sands appear and then at the Stony the river runs through a limestone bed. The rapids now consist chiefly of small cascades, which in high water are almost blotted out. The most important of them is the Grand Cascade, where there is a fall of about 6 feet in low water ; here the scows have to be unloaded and the goods portaged across, after which the scows are let down by ropes and then reloaded. The portage is less than 100 yards but the banks are steep, and one gets a fine exhibition of how not to handle articles labelled "glass with care," for unless you are there to personally look after such property it will receive the same treatment as the bags of flour, sacks of pork and such merchandise. After leaving this rapid it is only a short run to Ft. McMurray and the first stage of the journey is over. The rivermen return by trail to the head of the Grand Rapids to bring the next fleet of scows through. A halt is made for a day at McMurray, the scows are tied together, two and two, and one steersman and two oarsmen assigned to each pair ; everybody except the passengers having to work, and even they, from sheer desire to vary the monotony of having nothing to do but sit or lie about, are glad to relieve it by taking an occasional turn at the oars. Sometimes the scows are towed by a small steamer from here to Smith Landing, but owing to the low water the tug towing the Hudson Bay Co's. scows passed us with flying colors soon after leaving McMurray, but it had not gone far when it stuck on a sandbar and did not catch up again for a week. Chipewyan is the next objective and as one approaches Lake Athabaska on which it is situated, the ducks and geese become more numerous, the lake a verit-

able sportsman's paradise; the ducks and geese breed around the shores of the lake and in the fall of the year countless number of them are found. It is to be hoped that when the place becomes easy of access by the railway to Ft. McMurray, that the Government will adopt stringent regulations to prevent their extermination. Ducks are found in great numbers along the rivers and lakes all the way to the Arctic, but they are wild and it was not possible to fill the larder with them without losing much time, and as our work demanded haste we had to hurry on. Chipewyan was reached on the 1st of June; it is the most historic fort of the north, for it has been in existence since 1788 when it was founded by a cousin of Sir Alexander McKenzie; it was from here that Sir Alexander set out on his memorable voyages to the Arctic and Pacific, and that Sir John Franklin outfitted for his journeys to the Arctic. It now has an Anglican and a Roman Catholic mission, the latter having a large school, sawmill, farm, and several steamboats for the fisheries and for visiting the outlying stations. The Hudson Bay Co. has a serious rival in Colin Fraser, son of Sir George Simpson's famous piper, who has recently built a fine gasoline boat that plies between Ft. McMurray and Smith Landing. This boat towed the scows across the lake and to the mouth of the Peace River. The Peace River when Lake Athabaska is low flows both ways so that it is necessary to row, tow or sail the scows that far before they again get the current and can look out for themselves. After much bad weather Smith Landing was reached on the 9th of June, five weeks after leaving Athabaska Landing. By this time the ubiquitous mosquito was at the height of his career, making life miserable for man and beast; there is no escape except by drowning or protecting yourself with mosquito netting. At Smith Landing the river is obstructed by several very dangerous rapids, through which it is impossible to take scows. Formerly the rapids were passed by several portages, but now a wagon trail has been cut to Ft. Smith (16 miles) and all merchandise is freighted across on wagons. The horses, however, looked as if they had all they could do to get themselves across, let alone

taking a load, as it is, the loads vary from 12 to 20 cwt. Smith Landing is the headquarters of the mounted police for the district and the Indian agent lives at Ft. Smith. He is also postmaster, fire ranger, superintendent of the Government Farm and overseer of the reindeer obtained from Labrador, of which there is only one solitary representative remaining. The Catholic Mission opened a fine school and hospital there this season (1914). Ft. Smith is at the head of navigation of the Mackenzie system, and steamboats ply from here to the Arctic (1300 miles). Leaving by the Northern Trading Company's steamboat on June the 12th, we arrived the next day at Ft. Resolution on Great Slave Lake only to find that the wind had blown the ice in shore and that it was impossible to make the fort even with a small rowboat, as the ice was thin, much broken up and rotten and filled up the shallow waters of the bay right to the shore. The ice went out the next day with an off-shore wind, and allowed us to get in. From here arrangements had to be made for me to proceed the rest of the way by canoe. I was fortunate in being able to accompany Bishop Breynault, of the Oblate Fathers of Brittany, France, who carry on the Catholic Mission throughout the Mackenzie, as far as Ft. Providence. We set out on June 16th for Hay River, and were stopped that night by ice, but an off shore wind springing up in the morning enabled us to proceed and except at Sulphur Pt. (so called from the deposits of sulphur found there) where the ice blocked our way. It was piled up 20 or 30 feet high in places and delayed us for some hours so that we did not arrive at Hay River until after 2 a.m. Hay River, at the mouth of a river of the same name, is flat and only a few feet above the level of the lake. The Church of England Mission has an excellent school here and a farm where they grow large quantities of potatoes and vegetables, but very little, if any, grain. The place is also noted as having the farthest north horse in the district and, I believe, also the farthest north cattle. Leaving Hay River the same day with a fair wind, I had my first sight of the mirage, which was very beautiful but made it difficult to find our way. We entered the Mac-

kenzie shortly after midnight, but at that time of the year it was still quite light. A halt was made for a few hours' rest, but as the fishing appeared to be good, the temptation to try the troll was too great to be resisted and we were successful in landing a large *inconnu*. This fish, so called by Sir Alexander McKenzie because he did not know it, is a member of the salmon family and is found as far up the river as Ft. Smith, where its further progress is stopped by the rapids. They look like large salmon trout and some weigh as much as 60 and 70 lbs., but the most of them that are caught weigh from 10 to 20 lbs. It is one of the staple food fishes in the region and is valued next to the white fish. The largest specimens are found between Ft. Good Hope and the Arctic and I have been informed that they are also found in the Yukon although never very large ; it is caught usually in the nets, but it will take the troll and provides excellent sport. The staple food fish of the whole region is the white fish. Great Slave Lake teems with them and every year scow loads are obtained for all the posts within reach ; they form the principle article of diet for both man and dog. It is an interesting fact that the white people never tire of the white fish, and from the few that I had the privilege of sampling, I could easily understand that it is so. Even the dogs have their tastes as well as man and they prefer the white fish, but if it is not obtainable they will eat inconnu, or as they are generally called connie, and if neither of these is to be had, well ! under stress they will condescend to eat jack fish.

Shortly after noon of the day after we entered the Mackenzie I witnessed a most interesting phenomena, the formation of a thunderstorm right over us. Our first intimation of it was a few drops of rain, then a fair wind sprang up and we made good time ; the shower was fairly heavy and after having passed us it seemed to stand still about a mile away ; presently another and much heavier shower passed over and united with the previous one ; the wind by this time had died down ; a third cloud followed, by which time we were battling with a strong head

wind and lighting flashes were seen ; these phenomenæ continued until the whole sky was covered with black angry clouds from which ever and anon came vivid lightning flashes.

The current gradually became stronger and the same afternoon Ft. Providence was reached. Ft. Providence has a large Catholic school and mission and here I parted with the Bishop, who is not only a very interesting and agreeable companion but broad and liberal minded and highly respected throughout his diocese.

At Providence the Northern Trading Co. furnished me with a guide and a boat, and setting out the next day, the hundred miles of dead water was traversed without incident except a visit from an occasional Indian with whom we could generally trade some flour or tea, for fish, which formed a welcome change to our usual steady diet of bacon and bannock, and reached the Head of the Line, on the third day. It is here that the trackers in bringing up the York boats before the days of the steamboat were able to substitute the oars for the tracking line. At this place the river contracts to less than half its width and for the rest of the way the current runs from 3 to 8 miles an hour ; with this current it did not take long to reach Ft. Simpson at the junction of the Liard. The fort is built on an island and the breaking of the ice on the Liard is a most wonderful sight, but can only be witnessed by those who winter in the country. The Liard in its upper reaches is filled with dangerous rapids and the ice breaks in that part first ; it is forced down by the water and piled up on the ice below until the whole channel is blocked ; the water is thus held back until the pressure is sufficient to start another rush ; this is repeated again and again until it reaches the Mackenzie where at times the water rises until it almost overflows the island 40 ft. above the ordinary level of the river ; then as if gathering all its strength for a mighty onslaught, and with a terrific roar it crushes forward cutting a clear road through the ice right across the Mackenzie River. In the spring the Liard is very muddy, while the Mackenzie above the junction is beautifully clear and so great is the volume of

water flowing in these rivers that the waters are not thoroughly mixed for more than 100 miles below the junction. The Indians do not like to go far from home and that obliged me to change my guide at each post. The trip to Ft. Wrigley was made without incident, apart from the bush fires caused by the carelessness of the Indians, but my next guide who was to take me to Ft. Norman could not speak a word of English and I knew no Indian: we managed to understand each other quite easily, but conversation was limited. Just after leaving Wrigley he stood up in the boat and listened intently, then turning to me he shouted, the only word he apparently knew, "wind". I understood and we rowed for shore as hard as we could, just reaching it when the wind arrived and in a few minutes the river was running white. These squalls are very sudden and very fierce while they last, usually stirring up a very choppy sea that is liable to swamp any small craft that may get caught in them. The wind was now contrary and in order not to use up all one's energy rowing against the wind and being compelled to rest when the wind calmed down, resort was had to a water-horse. This is a small spruce tree about ten feet high with plenty of brush on it, on the end of which a stone is tied. Throwing it over-board, the tree sinks until about a foot of the top is above the water; the boat is hitched to this and the horse keeps in the strongest part of the current and takes you along almost as fast as the current. The boatmen can thus rest themselves and when it calms down take the oars again and make good time. In case of scows the plan is to use a water-sail instead of a wind-sail under similar conditions. The water-sail is simply a square sail tied on a mast and weighted at the bottom with stones so that it will sink; then if there is a side wind blowing, thus tending to blow the scow on shore, all that is necessary is to give the water-sail the proper angle and it will keep the scow in the strongest current. By this means it is possible to make good time against quite strong cross head winds. Time is an important factor and as it is light all night, instead of tying up, it is usual to make your bed as best you can in the canoe or boat and go to sleep allowing the

boat to drift all night. It keeps the current and as you occasionally wake up you find yourself turning round and round in an eddy; then getting free from it, the boat drifts on, one time at one side of the river and a little later at the other, thus, dodging the sandbars, but seldom sticking on them.

In this way Fort Norman was reached, at the junction of the Bear River, overlooking which is a high steep cliff called Bear Rock, and from which for a few days about the 21st of June the sun can be seen at midnight. Bear River is clear and cold, a delightful change from the mud that one has been accustomed to, from the Laird in the Mackenzie. Above Norman, smoke is seen issuing from the banks just as in Mackenzie's day. Few fish are caught between Providence and Norman but at this place the herring are numerous; they either go up to or come down from Great Bear Lake and in the fall of the year the inhabitants at Norman migrate to Great Bear Lake, for the herring fisheries, catching their winter's supply and bringing them down by scows. This is also one of the routes to Great Bear Lake and the Coppermine by the Dease River. It is also one of the best fur posts in the region, being specially noted for white foxes and caribou from the barren lands in addition to all kinds of foxes, martin, mink, etc.

My guide for the rest of the trip was a young Loucheux who had been to Hay River School where he learned English and cleanliness. On this portion of the river, the chief obstructions to navigation occur, the Sans Sault Rapids and the Ramparts. The approach to the rapids is indicated by wolverine rock, so called because one of the pinnacles looks somewhat like a wolverine and it is the bounden duty of every Indian to shoot at it, for the wolverine is his enemy, robbing his traps whenever the opportunity occurs. The Ramparts are the most interesting geological feature of the Mackenzie system. Above them the river is about three miles wide with a fairly strong current and as the Ramparts are entered it contracts suddenly to about 500 yards; yet in high water there is no sign of a rapid and the

current is only about five miles an hour. In low water just above the Ramparts there is a very dangerous rapid and a cascade with a fall of eight feet or more, making it dangerous for even a scow to go through. The Ramparts are formed by Devonian limestone rising from beneath the cretaceous through which the canyon is cut. The walls of the ramparts are vertical and rise from 100 to 250 feet above the river. It is frequently the scene of great ice jams and on one occasion the water is said to have risen over 100 feet and left a York boat stranded on top of the cliff. On emerging from the Ramparts, Ft. Good Hope, white and glistening, lay directly in front. Here the Northern Trading Co. and the Hudson Bay Co. have posts and as illustrative of the traditions of the Hudson Bay Co. and the loyalty of their servants it is said that the factor's little girl, at the Mission School at Providence, when asked why Adam and Eve were turned out of the Garden of Eden, replied that it was because they disobeyed the orders of the Hudson Bay Co.

It was necessary to make a stop here for several days to inspect the observatory and make arrangements for the despatch of balloons ; this was just finished when the boat bringing my supplies arrived and with the news that the Hudson Bay Co's. boat, the S.S. *Mackenzie River*, was, at least, a week behind ; this was good news to me for it meant that by hard work I could finish my work and return by the boat rather than cross the mountains and return by way of the Yukon. Stopping a day after the boat proceeded on its voyage, to finish my instructions to the observers, I again embarked and by travelling day and night reached Ft McPherson on the 12th July, the last day the sun was above the horizon at midnight, less than half being visible at its lowest dip. On this part of the trip, perhaps more than any other, one gets a view of the grandeur and immensity of the river. While drifting down between the high banks you do not realize the river is so big and you feel disappointed until you row across, but here it opens out and at one stretch called

the "Grand View" the river is straight with a water horizon before and behind for a distance of eighty miles.

The Eskimo from the delta of the Mackenzie make an annual pilgrimage to Ft. McPherson and Arctic Red River to trade when the steamers arrive; then they go to Herschell Island to meet the whalers from the Pacific. All that has been said about them in regard to their cheerfulness and business ability has not been exaggerated; they appear to be the happiest people I have ever met. The Church of England has a large and important work among them as well as with the Loucheux Indians.

Ft. McPherson is situated on Peel's River about thirty miles from its mouth, and until recently was the most northerly post of the Hudson Bay Co.; it was selected as the most suitable point from which to make the portage across the mountains to Rampart House and Fort Yukon, when these two posts were maintained by them, all the trade passing through McPherson.

One of the most interesting features of the trip down the river was the desire for information on the part of the white people and it made one realize how completely they are cut off from the outside world. The last news they had received was in regard to the Balkan War and they wanted to know how it ended, never dreaming that in a few days after that Europe would be plunged in war, about which they will not hear until March or later. Usually all the English-speaking people assembled and I tried to give them an account of the principal events of the past year.

On the 16th July, the S. S. *Mackenzie River* having discharged her cargo and taken on the fur, amid the shrieking of her whistle and the waving of handkerchiefs started on her long journey upstream, which was accomplished without incident. Between successive forts she had to spend several hours taking on wood and sometimes had to tie up and wait until the crew could cut enough wood to take her to the next fort. One evening there was great excitement when a large black bear was seen in the river in front of the boat. Every rifle on board was quickly

produced and when the bear was about seventy-five yards away they all opened fire, each one striving to be the first to hit poor bruin, but he was a strong swimmer and escaped.

The S.S. *Mackenzie River* is a splendid river boat, three feet in the water and over twenty feet out ; but on the lake if the wind begins to blow the boat begins to roll, and as the cargo of furs must be kept dry it is not possible to cross the lake except when it is almost calm.

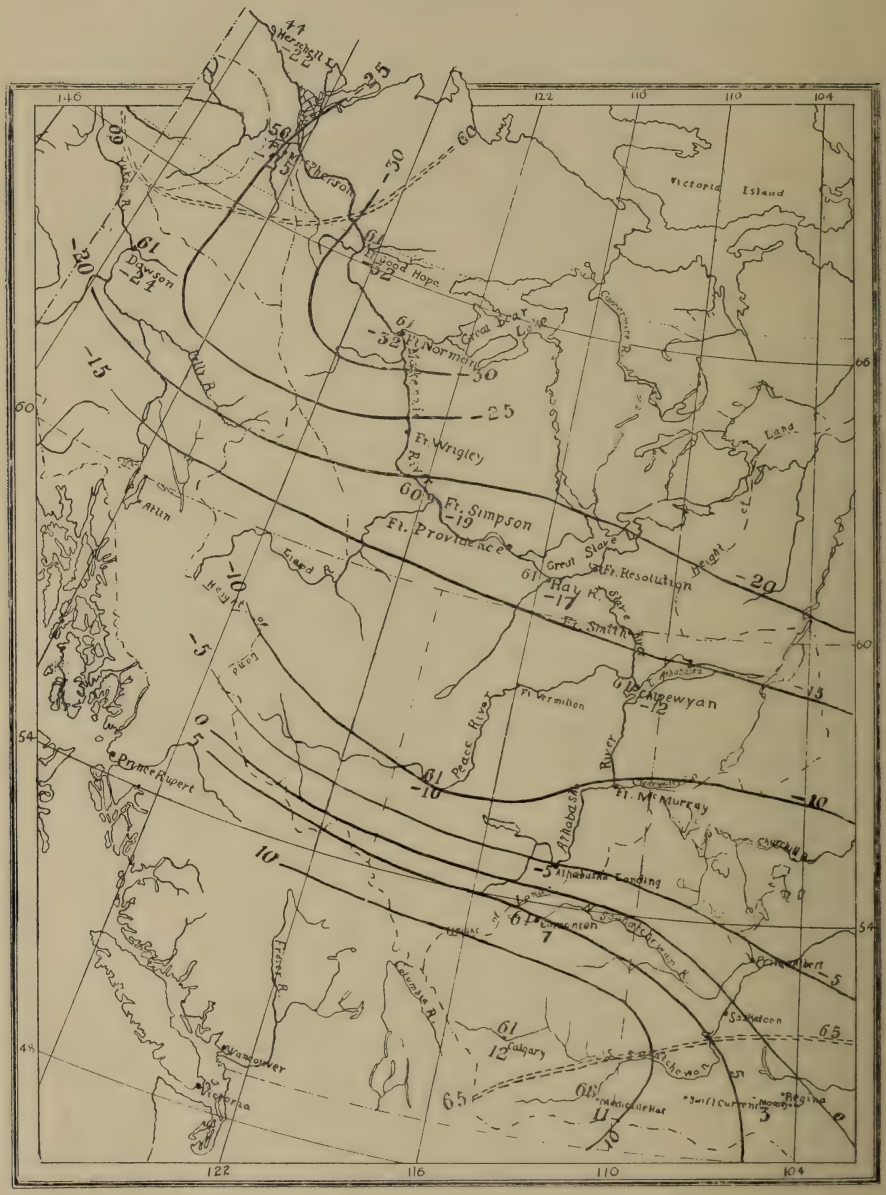
On the return journey a trip was made to Ft. Rae on the northern arm of Great Slave Lake. The Dogrib Indians usually trade at this place, and if those about the fort were representative of their tribe they are the most degenerate of all the Indian races.

Ft. Smith was reached on July 30th and the cargo of fur transferred by wagon to Smith Landing, where the S. S. *Grahme* was waiting to convey us to Ft. McMurray, which was reached on August 5th. Now began the most difficult part of the trip, as all the cargo of furs had to be taken up through the rapids. This could only be done by loading it into scows and tracking or towing them up the river ; each scow requires from six to ten men on the line, one man to steer and one in the bow to keep the scow off the stones. The rope is attached about a third of the way from the bow and this makes it an easy matter to keep the scow far out in the river ; in fact, the line can be almost at right angles to the boat and still make good progress. In smooth water, even though the current is strong, the men travel at a good gait, but when they have to get the boat up the rapids it often requires a double crew on the line and the progress at times is barely inch by inch. Again, when a small fall has to be surmounted at a sharp bend in the river, it is necessary to throw a line on shore from the bow of the boat, and it requires the utmost strength of several men pulling the bow straight in shore to prevent the scow from being thrown out into the stream or turning around and breaking away. The weather was very hot ; the men had to wade through mud knee deep, climb banks that were almost vertical, cross mountain torrents and surmount

rapids where all their strength had to be put forth for hours at a time. This gave one a glimpse of the labor involved and the price that has to be paid in getting the furs to the market. At the Grand Rapids the cargo had all to be packed for nearly half a mile and the scows pulled up through the boiling rapids ; no one is allowed in them as there is very great danger of the scow being filled with water and swamping when surmounting some of the wildest torrents of the rapids. A steamboat came down to meet us above the rapids and everyone thought that tracking was over for the season, but at one of the rapids, above the Grand, the boat had not power enough to get over the crest and again the men had to get out the ropes and everyone taking hold managed to track the steamboat over the crest and then without further incident Athabaska Landing was reached on August 25th, just in time to get the train to Edmonton.

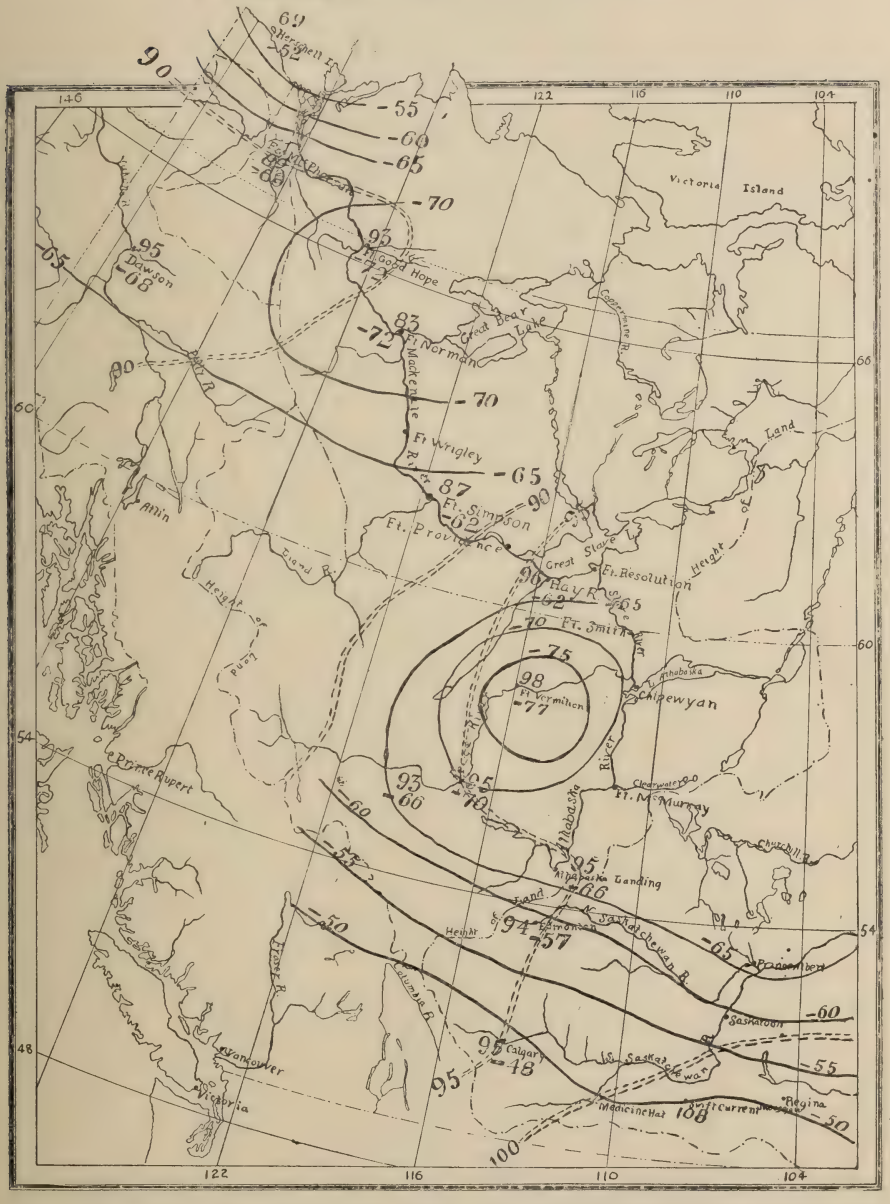
The Meteorological Service has stations at Ft. McMurray, Ft. Chipewyan, Ft. Smith, Ft. Resolution, Hay River, Ft. Simpson, Ft. Norman, Ft. Good Hope, Ft. McPherson and Herschell Island ; at all these stations observations have been taken for some years, but owing to the primary work of the observer often taking him far afield, it has been difficult to obtain continuous records ; in spite of the drawbacks, however, series of observations have been obtained which give a good indication of the climatological features of the area. As the heights of the stations above sea level are not known accurately, it has not been possible to reduce the barometer readings so that they can be compared with other stations in Canada.

In summer the weather is intensely hot and the sun's rays very strong, owing to the dry clear atmosphere. The chart showing the mean temperature for January and July shows the interesting fact that, from the Arctic Circle to the International Boundary mean temperature in July is between 60°F and 65°F. In the Arctic regions the ground never thaws out and at Ft. Good Hope is always frozen below three or four feet ; the gradual thawing, however, gives some moisture to the soil and prevents failure of the vegetable crop through lack of rain. Temperatures over



LINES OF EQUAL MEAN TEMPERATURES FOR JANUARY AND JULY

January isothermals, heavy full lines. July isothermals, dotted double lines.



ABSOLUTE HIGHEST AND ABSOLUTE LOWEST TEMPERATURES RECORDED

Absolute lowest isothermals, heavy full lines.

Absolute highest isothermals, double dotted lines,

90° F. have been recorded in the region and the high air temperatures combined with continuous daylight make it possible to grow vegetables at all the posts. Potatoes seldom fail as far north as Ft. Good Hope but have apparently never been tried at Ft. McPherson, as seed would have to be brought in the year before it was planted.

In the winter months the long clear nights permit of intense radiation, thus causing extreme cold. The temperature steadily decreases northwards until Ft. Norman and Ft. Good Hope are reached after which temperature begins to rise as the Arctic is approached. This is well illustrated in the charts giving the lowest minimum recorded at the different places and the mean temperature for the month of January. They show that the region between Good Hope and Norman is the coldest on the North American Continent and corresponds to the region in Siberia between Latitudes 62° N. to 68° N. and Longitudes 110° E. to 135° E. of Greenwich ; where mean temperature is 54° F. below zero during January. This region is in the same latitude as the Canadian zone and 100° of longitude west of it. The increase of temperature to the north of Good Hope does not mean that the climate is less severe for on the contrary it is more severe on both animals and plants.

The extreme range (the difference between the highest and lowest ever recorded) of temperature between summer and winter is very great and at Good Hope it is as much as 165° F.; at Toronto the extreme range is 130° F.

Rain-fall is light and occurs chiefly in July and August ; it is sometimes accompanied by severe lightning and thunder as far north, at least, as Ft. McPherson. The snowfall is also light ; in the Mackenzie River valley snow flurries sometimes occur in June and August but not in July.

The temperature and precipitation data are given in the following table.

Balloon observations in various parts of the world have shown that in the upper atmosphere a region is reached where the temperature ceases to decrease and after entering that region

TABLE GIVING THE MEAN TEMPERATURE FOR EACH MONTH, THE HIGHEST MAXIMUM, THE LOWEST MINIMUM, AND THE EXTREME RANGE AND YEARLY PRECIPITATION AT THE MACKENZIE BASIN

Station	Lat. N.	Long. W.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Highest Max.	Lowest Min	Extreme Range	Total Precipitation R	Total Precipitation S
	° ′	° ′																″	″
Herschell Island			- 22·0	- 12·3	- 12·1	2·1	19·2	35·5	44·1	41·3	36·3	16·0	- 6·1	- 14·5	69	- 52	121		
Ft. McPherson	67 27	134 51	- 25·2	- 21·8	- 8·2	7·8	30·4	51·7	58·5	53·9	35·7	14·3	- 10·2	- 17·4	89	- 68	157		39
Ft. Good Hope	66 16	128 54	- 31·6	- 26·1	- 12·3	14·5	35·1	56·3	61·2	53·0	38·7	16·6	- 15·2	- 25·0	93	- 72	165	1·51	66
Ft. Norman	64 55	125 41	- 32·2	- 25·4	- 12·6	14·7	35·9	57·0	61·2	53·0	38·8	15·9	- 17·7	- 25·4	83	- 72	155	6·58	55
Ft. Simpson	61 52	121 10	- 19·3	- 17·9	- 3·2	28·1	42·9	55·5	60·3	55·6	43·6	24·8	- 0·7	- 11·2	87	- 62	149	8·71	68
Hay River	60 51	115 43	- 16·8	- 10·9	1·5	26·1	41·2	51·3	61·5	58·0	45·5	31·7	7·2	- 6·0	96	- 62	158		
Ft. Chipewyan	58 43	111 10	- 11·9	- 9·1	5·0	28·5	44·5	54·0	61·5	58·1	45·2	33·7	11·0	2·2	93	- 56	149	8·59	50
Ft. Vermilion	58 27	116	- 14·8	- 3·9	11·8	32·0	49·3	57·9	61·0	57·1	47·3	33·1	14·0	- 1·7	101	- 77	178	7·52	36
Fond du Lac			- 22·6	- 16·2	2·3	18·6	38·4	53·4	58·8	54·4	44·2	32·5	11·0	- 5·7	90	- 61	151	7·53	28

the temperature is either constant or rises slightly ; this region is called the stratosphere and it is highest and coldest at the equator ; as one proceeds north or south from the equator, the stratosphere becomes warmer and approaches the earth ; in the latitude of Toronto, in winter it is about six miles above the surface and about 70° F. below zero ; the observations would indicate that as the pole is approached the stratosphere is less than six miles above the earth and its temperature about 65° F. below zero and may be higher. Now temperatures lower than this have been recorded in the Mackenzie area and in Siberia, suggesting that either the stratosphere reaches to the earth's surface at these points or else there is a great inversion of temperature. The latter seems the more probable and that there may be a large increase of temperature upward before it again begins to decrease towards the stratosphere.

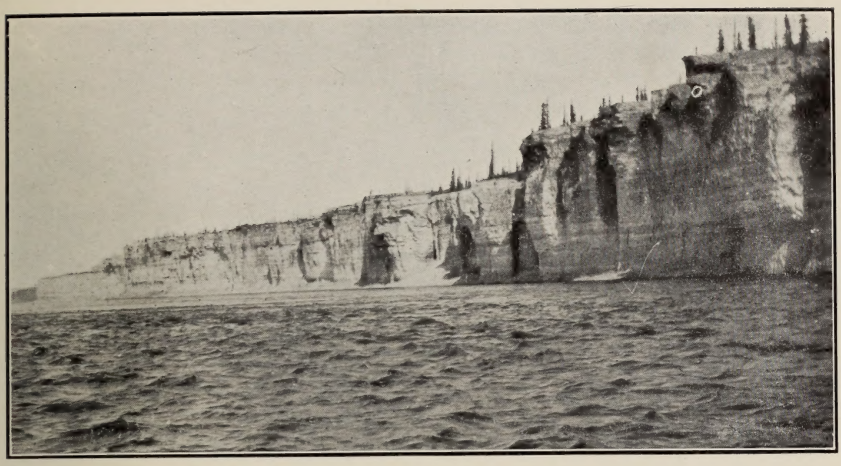
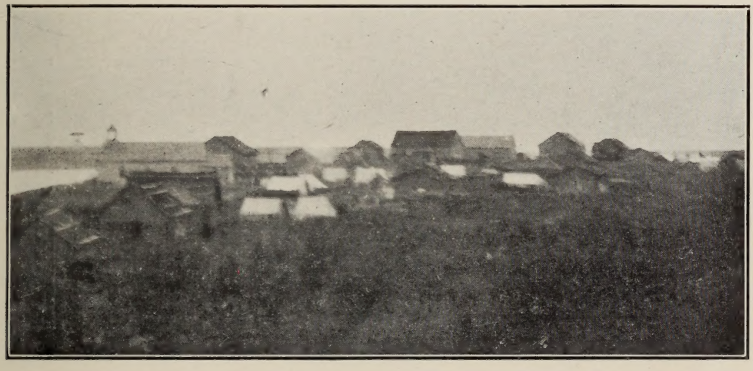
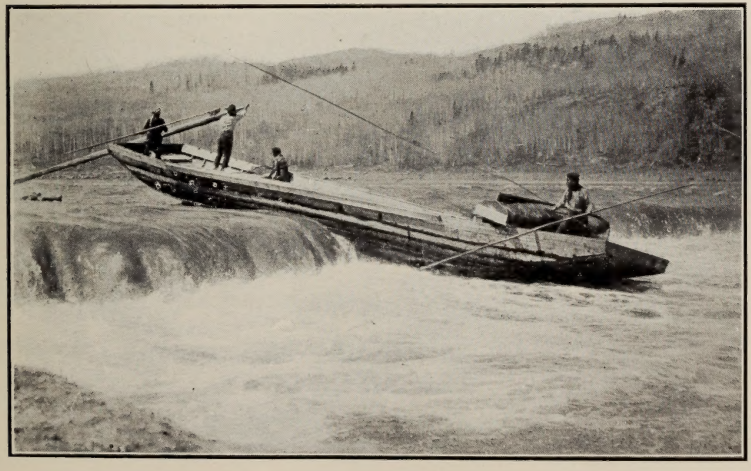


Photo by Bishop Breynault, O.M.I.

"THE RAMPARTS" (vertical walls of limestone and shale 125 to 250 feet high) Mackenzie River, near Fort Good Hope. At this point the river suddenly contracts from 3 miles to 500 yards, but in high water there is no sign of a rapid.



FORT McPHERSON (Lat. 67° 27′ N.). Taken on July 12 at midnight. About one-third of the sun is above the horizon (1 5/3 inches from left side of picture). Exposure 2 minutes.



Running a partly loaded scow over the Grand Cascade of Athabaska River. The bed of the river is limestone, and the fall is about six feet. In high water full loads are run over the Cascade.